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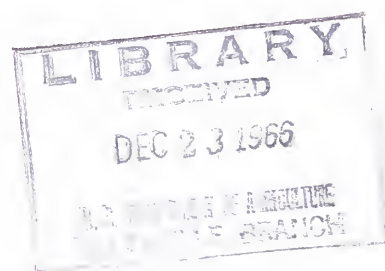
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# HOG SLAUGHTERING and DRESSING SYSTEMS



**Marketing Research Report No. 755**

**U.S. DEPARTMENT OF AGRICULTURE**  
**Agricultural Research Service**  
*in cooperation with*  
**OKLAHOMA AGRICULTURAL EXPERIMENT STATION**

## PREFACE

This report provides the meatpacking industry with data and guidelines that could be helpful in increasing the efficiency of hog killing-floor operations. Primarily, the study deals with the operations and layouts used in slaughtering and dressing an annual volume of 97,500 hogs.

The author acknowledges the assistance of the many individuals in midwestern and southern meatpacking plants who devoted much of their time to make this study possible. Manufacturers of slaughtering equipment were also helpful in providing cost data.

This work was conducted under the general supervision of Tarvin F. Webb, Investigations Leader, Transportation and Facilities Research Division, Agricultural Research Service.

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# HOG SLAUGHTERING AND DRESSING SYSTEMS

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## SUMMARY

Dressing-line operations cost about \$4,600 less a year for an annual volume of 97,500 head in hog slaughtering plants using systems with a powered rail or a chain conveyor in the bleeding area than in plants using a system with a gravity rail in the bleeding area. (Annual labor and equipment costs for the "gravity rail system" are \$39,858.) The gravity rail system, which uses a hoist to raise stunned animals from the landing table to the gravity rail for sticking and bleeding, has been commonly used in most hog slaughtering plants for many years. This study was based on half-day operations

and a dressing rate of approximately 100 hogs per hour, with the dressed weight averaging 185 pounds.

Labor and equipment costs per 100 head were \$40.88 for the gravity rail system, \$36.25 for the chain conveyor system, and \$36.21 for the powered rail system.

Layouts show the arrangement of equipment for the most efficient operations for each of the three systems, as found in the study. The gravity and powered rail systems require about 2,000 square feet of floor space. The chain conveyor system requires about 2,200 square feet.

## BACKGROUND

Hog slaughtering operations are performed in plants that slaughter and process hogs only or in plants that also slaughter and process cattle, sheep, chickens, or other animals. Hog slaughtering is most commonly done in conjunction with the slaughtering of cattle and calves. Separate slaughtering facilities for hogs must be installed because handling requirements for cattle and hogs differ. Labor, however, being more flexible than equipment, is often utilized to slaughter and process hogs as well as other animals. Common practice among most multispecies plants is to use the same crew to slaughter cattle in the morning and hogs in the afternoon.

In 1964, about 1,600 meatpacking plants in the United States were engaged in the slaughter of hogs. Operating costs are high in many of these plants because the methods and equipment used or the layouts of the facilities do not permit the greatest operational efficiency to be achieved.

This study was made to compare the relative efficiency and operating costs of methods and equipment and facility layouts used in slaughtering hogs. The study covered all operations performed from the time hogs enter the stunning chute until the dressed carcasses are weighed, excluding work on byproducts. During the course of the study, it was found that the various methods and equipment were most commonly found in three arrangements or systems. They are identified in this report as the gravity rail, the powered rail, and the chain conveyor

systems. The terms are derived from the method by which hogs are moved through the bleeding area. The most efficient methods of performing operations in each system were determined, and the operating costs of the three systems were compared. Layouts were developed to show the most efficient arrangement for each system, as found in the study. Some of the same methods and equipment are used in all three systems. Not all methods and equipment available to the industry are evaluated here because it would be impractical to consider the many variations that occur.

The study was based on plants slaughtering hogs 3.75 hours per day and averaging 97,500 hogs annually. The production rate in these plants was approximately 100 hogs per hour. Although production lines are designed to handle a specific number of hogs per hour, the design volume is seldom achieved. The net volume may be more or less than the design volume depending upon labor, materials, equipment, and methods utilized.

Research was conducted in hog slaughtering plants in Ohio, Indiana, Texas, Kansas, Mississippi, South Carolina, Alabama, Missouri, Tennessee, and Illinois. The study included about 25 plants selected to represent slaughtering rates of 60 to 150 hogs per hour. Operations in plants with smaller and larger production rates were also observed to obtain a volume perspective. Time studies were conducted in six plants representing a slaughtering rate of approxi-



mately 100 hogs per hour, with an average carcass dressed weight of 185 pounds.

The cost comparisons in this report make no provision for the costs of management or of owning the facility, or for other expenses generally classified as overhead. The study covered only the labor and equipment costs incurred in dressing-line work, excluding work on by-products.

Labor costs are based on the productive labor required for the operation plus the amount of idle time inherent in a particular method. For simplification purposes, all wage rates are standardized at \$2 per hour and exclude fringe benefits.

## SLAUGHTERING OPERATIONS

The operations involved in slaughtering hogs are generally performed in an established sequence, but the sequence can vary somewhat, depending on the equipment used or the volume of kill. The initial work consists of stunning the animals, and bleeding, scalding, and de-hairing the carcasses. In the remaining work (dress-finishing), the carcasses are singed, shaved, and washed; the heads are trimmed (faced) and removed from the carcasses; the carcasses are eviscerated and split in half; bruises and leaf fat are removed; and the carcasses are weighed.

The main differences among the three systems discussed in this report occur in the equipment and methods used in the initial operations. In the gravity rail system, the animals are shackled and hung on an overhead gravity rail while they are bled, and in the second system, the overhead bleeding rail is powered. In the third system, the animals are bled while lying on a chain conveyor that is about 2½ feet above the floor at its beginning and 5 feet or higher (varying in different plants) at the end, where the hogs are dumped into the scalding vat.

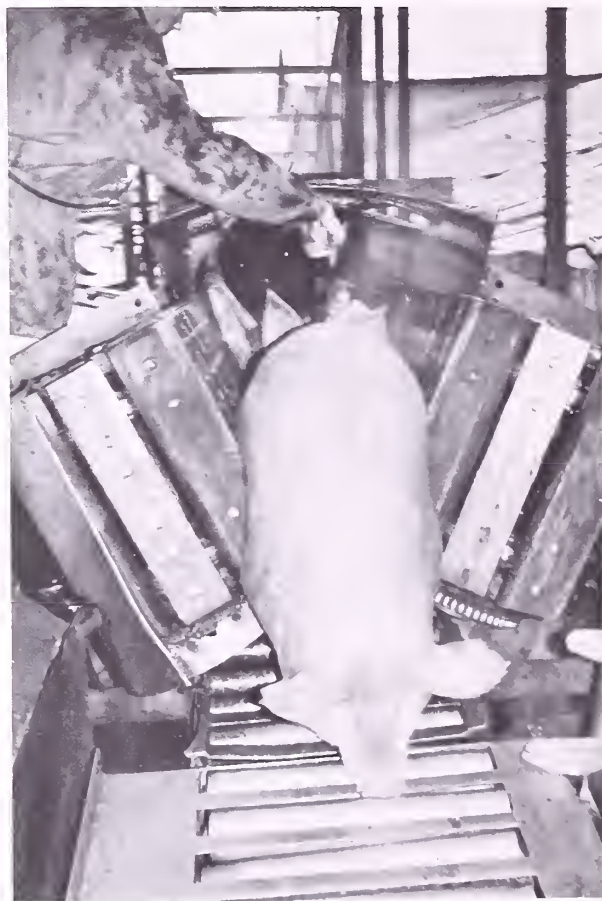
The dress-finishing work is usually performed in a similar manner in all three systems. All work done in the dress-finishing area in each system is performed on carcasses while they hang from an overhead rail. A drop-finger conveyor, termed as such because of the conveyor hanger design, automatically conveys all carcasses through most of the dress-finishing operations, beginning at the singeing area.

A large portion of the dress-finishing work is performed by workers standing on a platform located between the drop-finger conveyor and a viscera inspection conveyor.

Equipment cost data were obtained from manufacturers and are based on average f.o.b. factory costs for 1964 and 1965. Ownership and operating costs include fixed costs of depreciation, taxes, interest, and insurance, and variable costs of maintenance and repair, electricity, water, and gas.

The first section of this report describes hog slaughtering operations as they are generally performed in plants of the size studied, with the major variations in methods and equipment that occur. Layouts, labor requirements, and labor and equipment costs of each system are presented in the section, Hog Slaughtering Systems.

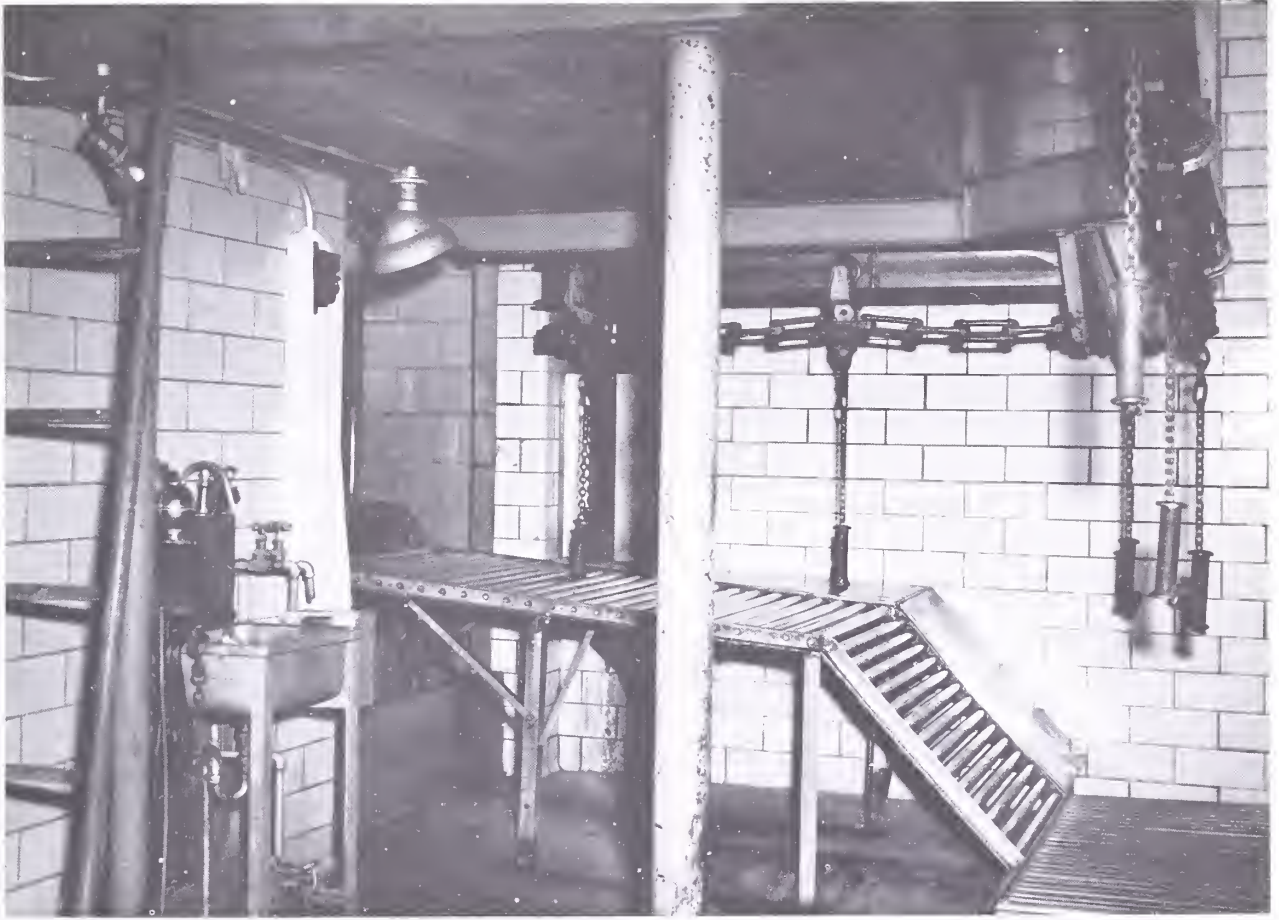
The operations covered in this study begin with stunning of the animals.



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FIGURE 1.—A V-shaped side-conveyor stunning pen. Stunned hog in foreground is being released from the pen onto a roller-conveyor; the worker is stunning the next hog in the pen.





BN-26416

FIGURE 2.—Overhead powered conveyor with shackles attached. Below the powered conveyor at left is the roller-conveyor where hogs are stuck.

### Stunning

Hogs enter the stunning area through a restraining chute. The restraining chute is usually fitted with a top constructed of pipe to prevent the hogs from climbing the sides. Electrical wires hang down at intervals from the top of the chute to touch the backs of the hogs as they pass through. The wires carry an electrical shock to the animals when the stunner actuates a switch, thus hurrying the animals along to the stunning pen.

Two types of stunning pen were studied—the side-squeeze pen and the V-shaped side-conveyor pen. The floor of the side-squeeze pen is a moving belt. The pen has two padded sides; one side presses against the hog and lifts it off the floor of the pen while it is stunned. After the hog is stunned the side is retracted, the hog drops onto the moving belt and is moved out of the pen onto a short roller-conveyor (landing table). The V-shaped side-conveyor pen

(fig. 1) has slot conveyors on each side that support and convey the animal. After the hog is stunned, it is dropped onto a landing table.

One worker is required to stun animals. The equipment used for stunning has been more or less standard in recent years since the advent of the humane act.<sup>1</sup> The worker places a pronged device against the animal's head that stuns the animal by electrical shock.

### Bleeding

The stunned animals are stuck either while on the landing table or after they are placed on the conveyor, depending on the type of conveyor used in the bleeding area. When the overhead gravity rail is used, a worker first attaches a shackle to one hind leg of the hog and to a hoist which raises the hog from the landing

<sup>1</sup> Humane Slaughter Act of 1958 (7 U.S.C. 1901-1906) Public Law 85-765, amended.

table to the gravity rail. A second worker sticks the hog after it is hung on the rail.

The powered rail has shackles attached at intervals; the conveyor (fig. 2) dips down to the roller-conveyor landing table. One worker sticks the hog while it is on the table and a second worker attaches the shackle.

The chain conveyor is a 21-foot-long conveyor inclined from about 2½ feet at the receiving end to 5 feet or higher at the discharge end. This conveyor carries the hogs as they are being bled. The hogs are stuck on the landing table. A hydraulically operated stick-plate attachment is used with the landing table. After a worker sticks the hog, he raises the table and the hog is automatically dumped onto the chain conveyor.

Each hog should be bled 4 to 6 minutes.

### Dropping

After they are bled, carcasses are dropped into the scalding vat. They are usually automatically dropped into the scalding vat when the powered rail or chain conveyor is used, but a worker must unshackle carcasses from the gravity rail. The worker who sticks hogs in this system is generally also assigned to dropping carcasses into the scalding vat. An automatic unshackling device is used in conjunction with the powered rail. The chain conveyor requires no dropping device; a short, stainless steel slide at the end of the conveyor guides each carcass into the scalding vat.

### Scalding

Scalding loosens the hair of hog carcasses, in preparation for hair removal in dehairing machines. Many packers have inefficient hog slaughtering operations because the temperature of the water in the scalding vat is not thermostatically controlled, and the scalding time for each carcass is not uniform. Many different sizes of scalding vats are used. The temperature of water in the vats ranges from 138° to 142° F., depending upon the length of the vat, and carcasses may be exposed for 3 to 7 minutes. One study made in the past decade showed that exposure to a temperature of 140° F. for longer than 4 to 6 minutes produces poor quality skins and gives rise to unsatisfactory dehairing.<sup>2</sup> The study also revealed that lower temperatures permit longer exposure without impairing quality or dehairing efficiency.

For a production rate of about 100 hogs per hour, a 27-foot vat is recommended. The water

temperature should not exceed 140° F. Under these conditions, hogs should remain in the vat from 3½ to 4 minutes for hair loosening, except during the hard hair season in the fall and spring, when 4 to 4½ minutes is recommended. Under-scalding will result in the need for excessive shaving time, and over-scalding causes cutting, nicking, or dark spots when the carcasses are shaved.

One worker attends the scalding vat. He uses a pike pole to turn carcasses and to push them along toward the end of the vat. He also maintains a constant lookout for sinkers—carcasses that sink to the bottom of the vat because of water in the lungs.

### Dehairing

Hydraulic machines used at the kill volume discussed in this report utilize powered cradles to dump hogs from the scalding vat into the dehairer and out of the dehairer onto the gambrelling table. One worker is in attendance to operate switches and to determine when hogs have been properly dehaired. The worker first actuates the throw-in cradle to dump two carcasses from the vat into the dehairer, retracts the cradle, and dumps another carcass on top of these two. The third carcass tends to hold the other two down to give better contact with the paddles. All three carcasses are dumped onto the gambrelling table at one time with the throw-out cradle when dehairing is considered completed. Proper maintenance of the dehairing machine paddles is considered of prime importance in obtaining properly dehaired hogs. Many packers fail in this respect.

### Gambrelling

When the carcasses are dumped out of the dehairing machine, they land on a stainless steel gambrelling table which has work platforms attached to each side. Each platform provides working space for one employee. One worker positions the carcass on the table, gets a gambrel for each carcass, removes toenails, and when necessary, scrapes excess hair from the head and foreleg areas. The other worker makes gam cuts in the hind legs, removes toenails, inserts the gambrel in the gam cuts, and attaches the gambrel to overhead trolleys which roll on a short section of gravity rail leaving the gambrelling area of work. A throw-off chute is installed below the rail where carcasses are pushed off the gambrel table (after being attached to the trolleys) to absorb the shock of the dropping carcass (fig. 3). Gambrelling operations are generally performed in the same manner in plants of the size discussed here.

<sup>2</sup> American Meat Institute Foundation. Circular 32. April 1957.





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FIGURE 3.—Hog carcasses being placed on overhead rail after the gambrelling operation.

### Singeing

The singeing operation is necessary to remove any fine and light-colored hairs left on the carcass and also to show up the coarser light-colored hairs for shaving.

Singeing is done either automatically in a singe cabinet or by a worker with a singe torch. The latter method was usually found incorporated with the gravity rail system of kill.

Automatic singe cabinets are installed in most newer hog killing systems and are located a few feet from the gambrelling table, at the beginning of the powered, drop-finger conveyor system. The hogs are conveyed at intervals of about  $2\frac{1}{2}$  feet through the cabinet. A control mechanism, actuated by the trolley passing into the cabinet, turns on a multinozzle burner which singes the carcass from both sides and bottom. The burner switches off after each carcass. Dehairing operations have not been perfected to allow the elimination of the singeing work.

Manual singeing is also done at the beginning of the drop-finger conveyor.

Immediately after either manual or automatic singeing, carcasses pass under overhead

water sprays; wetting the carcasses aids in the subsequent shaving operations.

### Shaving

Shaving is done by workers with hand knives. The number of workers required depends upon the efficiency of the scalding and dehairing operations. The number varied from three to five men in the plants studied.

Three workers—a ham shaver, side shaver, and head and shoulders shaver—were considered to be adequate for an efficient operation using recommended procedures and present-day scalding and dehairing methods (fig. 4). The ham and side shavers are usually provided platforms of sufficient height to allow the proper working level for each job. A lavatory is provided near each platform for washing hands and knives after each carcass is processed.



BN-26407

FIGURE 4. View of line showing three shavers on platforms at left and the facer on floor level at right.

### Washing

Washing removes loose hair and blood from the outer carcass before it is deheaded. A wash cabinet similar in construction to the singe cabinet is used in most operations of this size. The cabinet has a series of fine spray nozzles which automatically spray water on the carcasses as they pass through the cabinet on the powered rail.



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FIGURE 5.—Worker removing the head from a carcass.

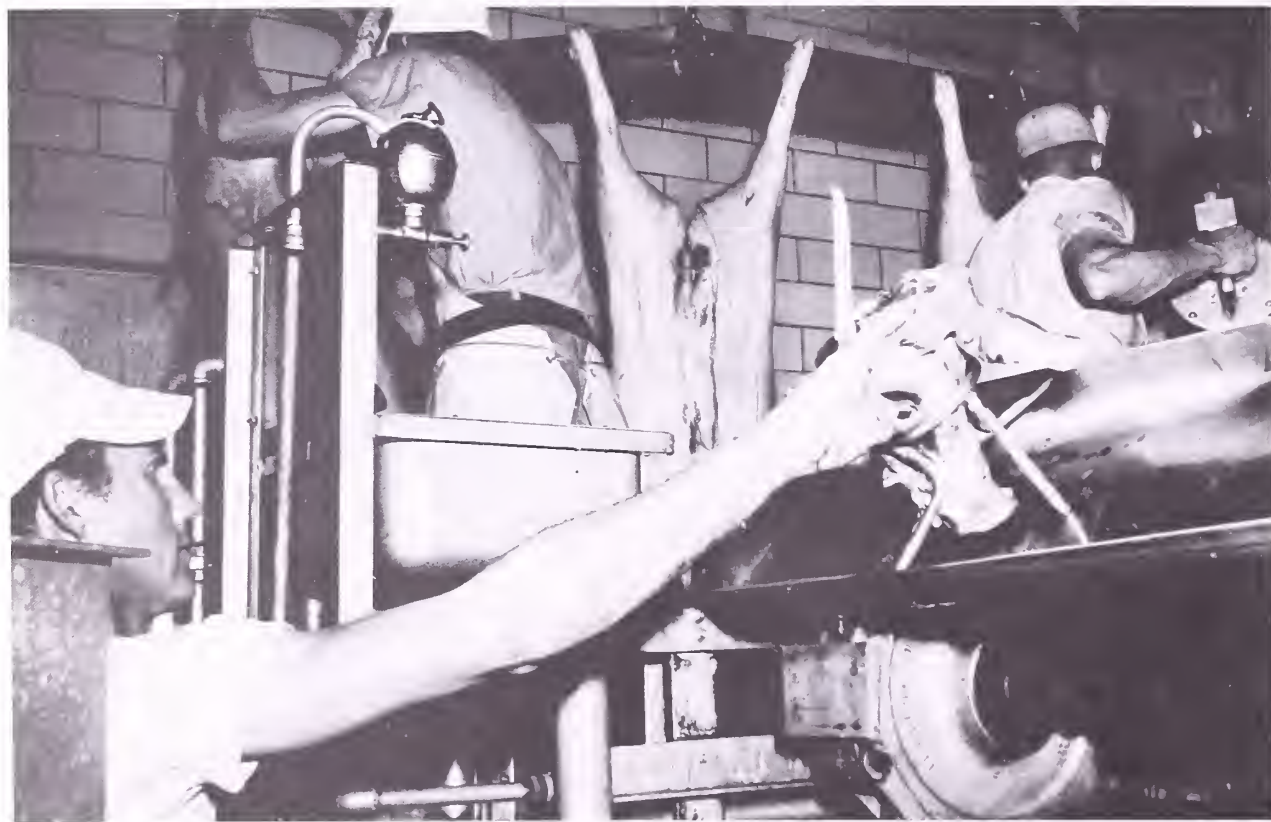
### Facing

Facing includes the removal of eyelashes and eardrums, skinning of the face, and other trimming which may be deemed necessary by the worker. The facer works from floor level (see fig. 4) using a hand knife, and shares a sterilizing lavatory with the deheader. During the hard hair season, this worker may also be used to perform some of the shaving work.

### Deheading

The header works at floor level. He removes the head (fig. 5) from each carcass with his knife, leaving as much of the jowl on the carcass as possible. He places the head on a head rack (fig. 6) on the viscera inspection conveyor. The viscera inspection conveyor holds a series of stainless steel pans for viscera and racks for carcass heads.

Various arrangements in the work may be found which fit a particular operation, but the header usually also makes a cut to open the breastbone or sternum.



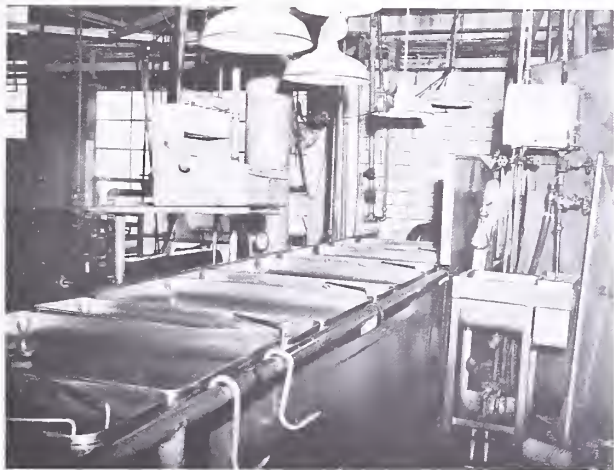
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FIGURE 6.—Worker placing head on head rack on viscera inspection conveyor.



### Eviscerating

Evisceration is the first operation performed from the work platform opposite the viscera inspection conveyor. In plants of this size, the viscera inspection conveyor is 24 feet long; it is usually about 5 feet 4 inches high (fig. 7).



BN-26415

FIGURE 7.—A viscera inspection conveyor.

The viscera inspection conveyor is synchronized with the drop-finger conveyor to enable workers to keep the head and viscera together for easy identification with the carcass. One worker, standing on a 3-foot high platform, makes an incision from lung to breast, removes the internal organs, including the liver, heart, lungs, large and small intestine, pancreas, spleen, stomach, bladder, and fat, and places them in one of the stainless steel pans on the viscera inspection conveyor. The pizzle and bladder are removed and thrown into a barrel or tub truck. Kidneys are left on the carcass.

### Splitting

After evisceration, the next worker on the line, standing on a platform adjacent to the eviscerator, splits the carcass down the center of the backbone using a hog carcass power saw with a circular blade. The carcass is split with the belly side facing the worker. The worker also washes the inside of the carcass. Facilities are available for rinsing the saw after each use.

### Inspecting

The viscera and carcass are inspected by employees of the local, State, or Federal meat inspection service. Carcasses which are condemned or retained by the inspector are run off on a short section of rail. Carcasses that pass

inspection continue on the rail to the next operation.

Since inspectors are not employees of the processing plant, their work is not considered in the cost evaluations in this report.

### Bruise trimming

An experienced butcher, usually working in conjunction with the inspector, carefully inspects each carcass side and removes bruised spots and blemishes from the carcass, being careful not to remove too much of the meat not directly affected. The removed parts are considered inedible and treated as such.

### Leaf fat pulling

The leaf fat hangs on the inside flank of each carcass side. The puller (fig. 8) takes hold of



BN-26405

FIGURE 8.—Worker pulling leaf fat.

the lower fat with one hand, and pushes his other fist between the fat and flank of the side to loosen the fat from the carcass. The fat may be thrown into chutes or trucks for transport to the rendering department. In the three dress-

ing systems studied, the worker performed from a stationary work platform and carcasses were conveyed past him on the powered rail, except in the gravity rail system which provided an arrangement requiring the worker to manually push the carcass to and from his work area (see diagram of gravity system in figure 10).

Most packers face hams at this work station by removing the skin on the inside of each ham to expose a greater portion of the lean on the ham. The puller cuts away the skin and surplus fat around the inside of each ham to a point near the backbone. This work is more easily done while the carcass is still hot.

### Weighing

The carcasses are usually weighed in groups of four or five before they are moved into the cooler. The worker must move the carcasses on a gravity rail from the leaf fat pulling station onto the track scales, record the weight, and move them off the scales (fig. 9). This worker may also wash the inside neck area prior to weighing.

After he weighs the carcasses, this worker stamps each carcass side with the inspection stamp at several places on the inside and the outside, to complete the line operations on the kill floor.



FIGURE 9.—A worker pushes five carcasses at a time off the scales.

## HOG SLAUGHTERING SYSTEMS

The foregoing discussion of slaughtering operations presents the general requirements of dressing-line work in most plants which process hogs at a rate of about 100 per hour. This section of the report presents specific requirements of the gravity rail, powered rail, and chain conveyor systems. In addition to the differences in type of bleeding rail, these systems differ as follows: (1) The gravity rail system uses hand-singeing of carcasses and the gravity rail extension of the drop-finger conveyor at the leaf fat pulling station; (2) the powered rail and chain conveyor systems both use automatic singeing and the powered drop-finger conveyor at the leaf fat pulling station.

The labor requirements, labor and equipment costs, and layouts presented here were based on the types of equipment most commonly used in each system as found during the study.

### Gravity rail system

The gravity rail system requires 18 workers and 1,995 square feet of floor space for dressing-line operations.

#### Layout

A layout of the gravity rail system is shown in figure 10. Equipment and work arrangements are shown only for dressing-line operations. This was the most efficient layout of the gravity rail system found in the study. For this system layout, dressing-line operations include the following work areas: (1) Stunning, (2) bleeding, (3) scalding, dehairing, and gambrelling, and (4) dress finishing.

This particular arrangement differs largely from other systems in the use of a hoist to raise stunned animals from the landing table to an overhead gravity rail for sticking and bleeding. Another major difference in layout is that the powered drop-finger conveyor system ends at the bruise trimming station.

**Stunning area.**—A side-squeeze stunning pen is used in this layout. A work platform is provided on one side of the pen to allow the employee to work at the proper height. The stunning area, including space for one worker, the pen, platform, and electric stunner, is about 8 by 10 feet.



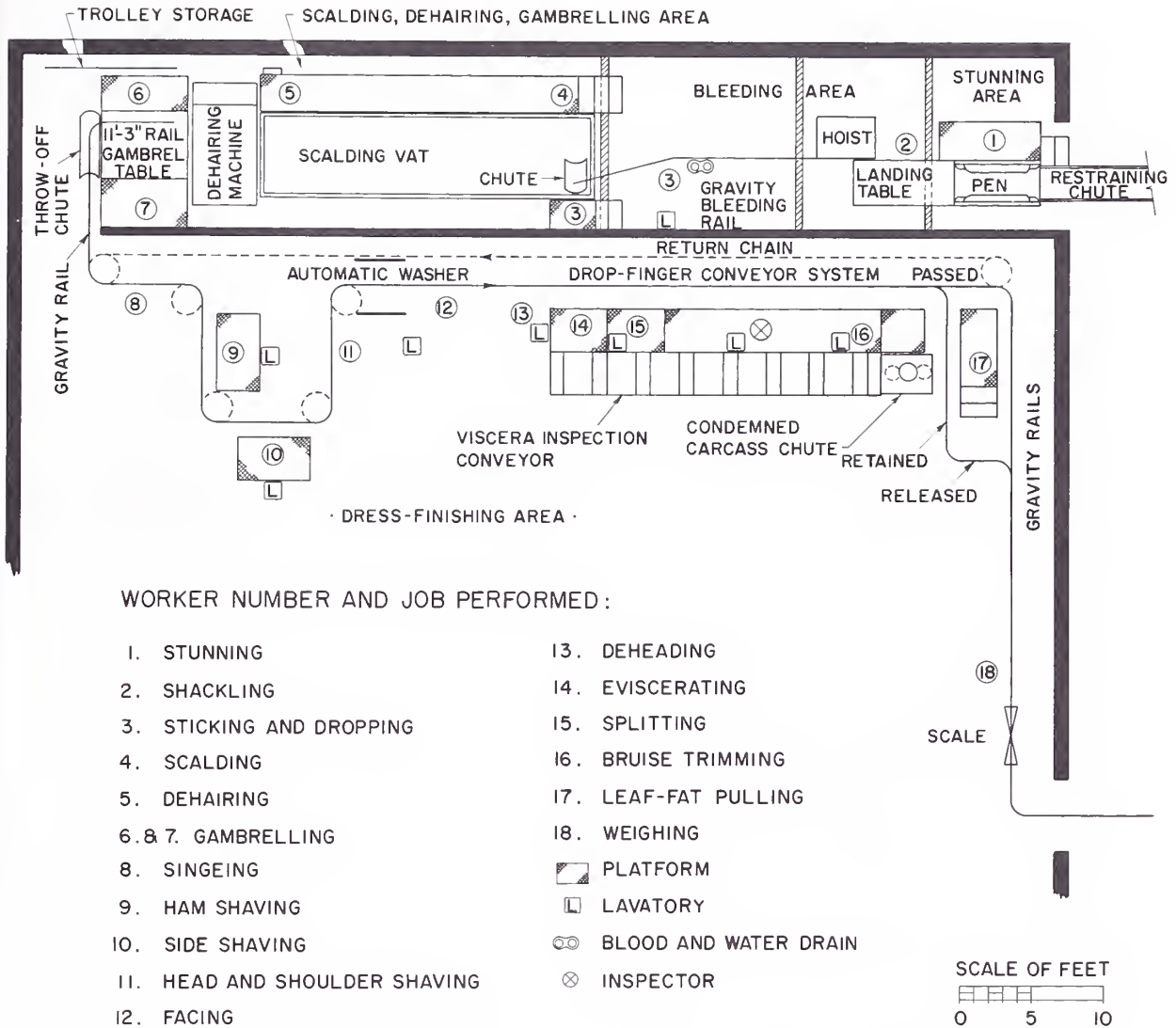


FIGURE 10.—Layout of a gravity rail slaughtering system that handles about 100 hogs per hour.

**Bleeding area.**—This area provides space to conduct the work of sticking, shackling, and hoisting carcasses to the overhead gravity rail, and to allow bleeding of carcasses. The 13-foot-long gravity bleeding rail extends from a jerkless hog hoist to a point above the scalding vat. A short section of roller-conveyor for landing hogs after stunning, a blood and water drain, and a sterilizing lavatory are also located in the area. The jerkless hog hoist employs an endless moving chain with hooklike attachments at intervals on the chain to engage shackle hooks. About 10 by 13 feet of the bleeding area is a separately curbed, raised concrete floor used for collecting the blood flowing from carcasses. The portion of gravity rail extending over this curbed section is about 10½ feet above the floor

and slopes at a rate of about three-fourths of an inch per foot from the hoist to the scalding vat. Rail stops are placed at intervals on the rail to allow the worker to stick animals before they bunch up. Working space for two employees is provided.

**Scalding, dehairing, gambrelling area.**—An area 10 by 40 feet is required to provide adequate space for a 27-foot-long scalding vat with work platform and dropper's platform, dehairing machine, gambrelling table with two work platforms, throw-off chute, and trolley storage. The dropper, vat attendant, dehairer attendant, and two gambrelling men work in this area. A drop chute is installed near the end of the bleeding rail to allow carcasses to slide into the

vat when they are dropped from the rail. A gravity rail above the gambrelling table leads to the drop-finger powered conveyor system. A chute below this rail absorbs the shock of carcasses dropping off the gambrelling table when they are hung on the rail.

**Dress-finishing area.**—This area includes all of the remaining line operation work and is separated from the other areas by a full-height wall. About 1,340 square feet is required for equipment and work space, excluding space for byproducts and supporting work. Work platforms for the ham shaver, side shaver, eviscerator, splitter, inspector, bruise trimmer, and leaf-fat puller are provided, along with an automatic wash cabinet, viscera inspection conveyor, track scales, chute for condemned carcasses, seven sterilizing lavatories, and a drop-finger conveyor system with a gravity rail extension. Working areas for 11 employees and an inspector are shown on the layout. The operations performed in the dress-finishing area are: Singeing (done manually in this system), ham shaving, side shaving, head and shoulders shaving, automatic



BN-26410

FIGURE 11. Carcasses being conveyed on powered drop-finger conveyor system.

**TABLE 1.**—Gravity rail system: Crew organization, labor requirements, and labor and equipment costs to slaughter 100 hogs, by operation

[Based on an annual volume of 97,500 hogs and average dressed carcass weight of 185 pounds]

Operation	Crew size	Labor requirements				Costs	
		Productive	Unproductive <sup>1</sup>	Total	Equipment	Labor	Total
	Number	Man-hours	Man-hours	Man-hours	Dollars	Dollars	Dollars
Stunning .....	1	0.48	0	0.48	1.01	0.96	1.97
Shackling .....	1	.36	0	.36	.54	.72	1.26
Sticking and dropping .....	1	.60	.37	.97	.16	1.94	2.10
Scalding .....	1	.62	.35	.97	.61	1.94	2.55
Dehairing .....	1	.81	.16	.97	1.64	1.94	3.58
Gambrelling .....	2	<sup>4</sup> 1.40	.54	1.94	.64	3.88	4.52
Singeing .....	1	.84	.13	.97	.09	1.94	2.03
Ham shaving .....	1	.84	.13	.97	.17	1.94	2.11
Side shaving .....	1	.81	.16	.97	.16	1.94	2.10
Head and shoulder shaving .....	1	.85	.12	.97	.10	1.94	2.04
Facing .....	1	.74	.23	.97	.10	1.94	2.04
Deheading .....	1	.88	.09	.97	.51	1.94	2.45
Eviscerating .....	1	.86	.11	.97	.52	1.94	2.46
Splitting .....	1	.86	.11	.97	.94	1.94	2.88
Bruise trimming .....	1	.72	.25	.97	.59	1.94	2.53
Leaf fat pulling .....	1	<sup>5</sup> .97	0	.97	.12	1.94	2.06
Weighing .....	1	.92	0	.92	.15	1.84	1.99
Subtotal .....	18	13.56	2.75	16.31	8.05	32.62	40.67
Automatic wash .....	—	—	—	—	.21	—	.21
Total .....	—	—	—	—	8.26	—	40.88

<sup>1</sup> Job-regulated wait time caused by irregular flow of work between operations.

<sup>2</sup> Excludes 0.49 man-hour devoted to driving.

<sup>3</sup> Excludes 0.61 man-hour devoted to driving.

<sup>4</sup> Includes time for two workers at 0.72 and 0.68 man-hour.

<sup>5</sup> Leaf fat pulling is pace-setting operation.

<sup>6</sup> Excludes 0.05 man-hour devoted to work in chill room.



washing, facing, deheading, eviscerating, splitting, bruise trimming, leaf fat pulling, and weighing.

The powered drop-finger conveyor system begins just before the singeing operation and conveys carcasses on 2½ foot centers (fig. 11) through all operations to a point just before leaf fat pulling, where the gravity rail extension begins.

Sterilizing lavatories, as shown in figure 10, are located at the ham shaving, side shaving, head and shoulder shaving, deheading and eviscerating, splitting, inspecting, and bruise trimming stations.

### **Labor Requirements and Labor and Equipment Costs**

Table 1 presents the crew organization by operations, the productive and unproductive labor requirements, and the labor and equipment costs per 100 hogs for the gravity rail system. The elapsed time to slaughter 100 hogs is 0.97 hour, the time required for leaf fat pulling, which is the pace-setting operation. Unproductive labor is the difference between the pace-setting operation time of 0.97 hour and the time required for the other operations. No unproductive time is shown for the stunning and shackling operations because the stunner and shackler spend their wait time helping to drive hogs into the restraining chute.

The high labor requirements make this the most costly system to operate even though the equipment cost per 100 hogs is the lowest of the three systems. The hand singeing operation in this system accounts for one full-time man more than the other systems. Time for leaf fat pulling is greater than in the other systems because the worker must push the carcass through the work area; in the other two systems, the drop-finger conveyor extends past this work area. The gravity rail system also requires more time for shackling, sticking, and dropping than the other systems due to the use of the jerkless hoist, which requires a longer time for a worker to shackle, and because of the arrangement for one worker to stick and drop. One advantage the gravity system has over the other two systems is that slightly less floor space is required, mainly because less space is needed for the bleeding rail.

Equipment requirements and cost allocation by operations are shown in appendix table 6. Elements of productive labor, by operation, are in appendix table 9.

### **Powered rail system**

The powered, captive-shackle bleeding rail has an automatic unshackling device for drop-

ping each carcass from the bleeding rail into the scalding vat. The system requires 2,005 square feet of space and 17 employees for the dressing-line operations.

### **Layout**

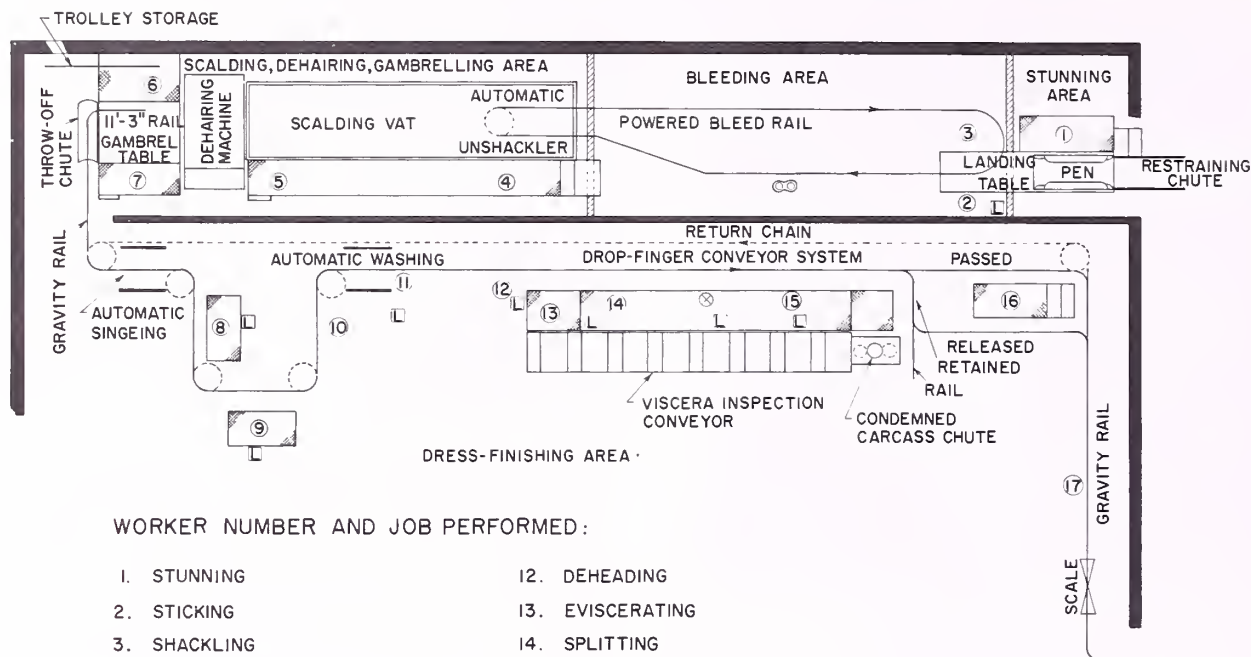
The most efficient arrangement of the powered rail system found in the study is illustrated in figure 12. The work areas are discussed under (1) stunning, (2) bleeding, (3) scalding, dehairing, gambrelling, and (4) dress finishing. The powered drop-finger conveyor in this system conveys carcasses from the singeing operation through the leaf fat pulling operation.

**Stunning area.**—The stunning area in this system is identical to that previously discussed under the gravity rail system.

**Bleeding area.**—A separately curbed and drained 10- by 30-foot area is required for the work of bleeding animals. This provides adequate space for the conveying of carcasses at 2-foot intervals and the return of the endless-chain, captive-shackle bleeding rail. A short section of roller conveyor is used as a landing table and for sticking animals. The bleeding rail dips down as it passes over the landing table so that shackles are in position for attachment to carcasses. The speed of the rail is set to allow the desired bleeding time for net production of about 100 carcasses per hour. For 5-minute bleeding, the rail would travel about 6 feet per minute. Two employees, the sticker and shackler, work in the area. A blood and water drain and a sterilizing lavatory are also located in the area.

**Scalding, dehairing, and gambrelling area.**—This area is similar to that of the gravity rail system except that an automatic unshackling device eliminates the need for a platform, drop chute, and labor to drop carcasses into the scalding vat. Also, the work platform for the dehairer and vat attendant is located on the opposite side of the vat (see fig. 12), and the drive for the dehairing machine is on the opposite side of the machine.

**Dress-finishing area.**—Excluding space for byproducts and supporting work, about 1,450 square feet are utilized in the dress-finishing area with this system. The equipment used is the same as that in the gravity rail system except that an automatic singeing cabinet (fig. 13) eliminates the need for one man. Also, the powered drop-finger conveyor extends through the leaf fat pulling station, eliminating the need for manual pushing on the rail through this operation.



#### WORKER NUMBER AND JOB PERFORMED:

- |                               |                         |
|-------------------------------|-------------------------|
| 1. STUNNING                   | 12. DEHEADING           |
| 2. STICKING                   | 13. EVISCERATING        |
| 3. SHACKLING                  | 14. SPLITTING           |
| 4. SCALDING                   | 15. BRUISE TRIMMING     |
| 5. DEHAIRING                  | 16. LEAF-FAT PULLING    |
| 6. & 7. GAMBRELLING           | 17. WEIGHING            |
| 8. HAM SHAVING                | □ PLATFORM              |
| 9. SIDE SHAVING               | □ LAVATORY              |
| 10. HEAD AND SHOULDER SHAVING | ⊗ BLOOD AND WATER DRAIN |
| 11. FACING                    | ⊗ INSPECTOR             |

SCALE OF FEET



FIGURE 12.—Layout of a powered rail slaughtering system that handles about 100 hogs per hour.



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FIGURE 13.—Carcasses entering automatic singe cabinet.

#### Labor Requirements and Labor and Equipment Costs

The crew organization, labor requirements, and labor and equipment costs per 100 hogs are shown in table 2. The pace-setting operation with the powered rail system is deheading at 0.88 hour per 100 carcasses. The backlog rail ahead of the weighing area eliminates the weighing operation as the pace setter. All unproductive time is figured as the difference or wait time between deheading and the other operations, except for stunning, sticking, and shackling. The workers in stunning, sticking, and shackling perform driving work during their wait time.

The powered rail system requires one less worker than the gravity rail system, because an automatic singer is used. Other labor savings occur because the pace-setting operation takes less time and because carcasses are automatically dropped into the scalding vat. The time required for the leaf fat pulling operation is shortened because the powered rail section extends past this work station. With the work of dropping eliminated, the two sticking and

TABLE 2.—*Powered rail system: Crew organization, labor requirements, and labor and equipment costs to slaughter 100 hogs, by operation*

[Based on an annual volume of 97,500 hogs and average dressed carcass weight of 185 pounds]

Operation	Crew size	Labor requirements			Costs		
		Productive	Unproductive <sup>1</sup>	Total	Equipment	Labor	Total
	Number	Man-hours	Man-hours	Man-hours	Dollars	Dollars	Dollars
Stunning .....	1	0.48	0	20.48	1.01	0.96	1.97
Sticking and shackling .....	2	3.90	0	4.90	.45	1.80	2.25
Scalding .....	1	.62	.26	.88	.75	1.76	2.51
Dehairing .....	1	.81	.07	.88	1.64	1.76	3.40
Gambrelling .....	2	51.40	.36	1.76	.64	3.52	4.16
Ham shaving .....	1	.84	.04	.88	.17	1.76	1.93
Side shaving .....	1	.81	.07	.88	.16	1.76	1.92
Head and shoulder shaving .....	1	.85	.03	.88	.10	1.76	1.86
Facing .....	1	.74	.14	.88	.10	1.76	1.86
Deheading .....	1	6.88	0	.88	.51	1.76	2.27
Eviscerating .....	1	.86	.02	.88	.52	1.76	2.28
Splitting .....	1	.86	.02	.88	.94	1.76	2.70
Bruise trimming .....	1	.72	.16	.88	.59	1.76	2.35
Leaf fat pulling .....	1	.82	.06	.88	.12	1.76	1.88
Weighing .....	1	7.92	0	.92	.15	1.84	1.99
Subtotal .....	17	12.51	1.23	13.74	7.85	27.48	35.33
Automatic singe .....	—	—	—	—	.67	—	.67
Automatic wash .....	—	—	—	—	.21	—	.21
Total .....	—	—	—	—	8.73	—	36.21

<sup>1</sup> Job-regulated wait time caused by irregular flow of work between operations.<sup>2</sup> Excludes 0.40 man-hour devoted to driving.<sup>3</sup> Includes time for two workers: Sticker 0.45 man-hour; shackler 0.45 man-hour.<sup>4</sup> Excludes 0.86 man-hour devoted to driving.<sup>5</sup> Includes time for two workers at 0.72 and 0.68 man-hour.<sup>6</sup> Deheading is pace-setting operation.<sup>7</sup> Not considered as pace-setting operation because rail backlog area is available.

shackling workers, who are close to the driving area, help drive hogs into the pen during wait time on dressing-line operations.

Labor and equipment costs per 100 hogs are \$36.21, or about 11 percent less than costs of the gravity system.

The method of allocating equipment and costs by operation is shown in table 7 of the appendix. Table 10 of the appendix gives the elements of productive labor for dressing-line operations.

### Chain conveyor system

The chain conveyor system requires 16 workers and 2,230 square feet for dressing-line operations. Except for the bleeding conveyor and the type of stunning pen used, this system is very similar to the powered rail system.

The system requires one less worker than the powered rail system because carcasses do not have to be shackled to the bleeding conveyor.

#### Layout

Figure 14 shows the most efficient layout of the chain conveyor system found in the study.

The dressing-line work includes areas for (1) stunning and bleeding, (2) scalding, dehairing, and gambrelling, and (3) dress finishing.

**Stunning and bleeding area**—Hogs are brought to the stunning pen through a restraining chute similar to the one used in the other two dressing-line systems. The V-shaped stunning pen is installed on a slight incline so that the side conveyor lifts each hog off the floor as it is moved toward the stunning end of the pen. The pen is 14 feet long. After each hog is stunned, it is dumped onto a short section of roller conveyor.

A hydraulically operated stick-plate attachment, which is located under the roller conveyor landing table, is used to raise the table to dump carcasses onto the chain conveyor after they are stuck. The bleeding conveyor is 21 feet long and travels at a speed to allow a 4- or 5-minute bleeding time. A short stainless steel slide at the end of the conveyor guides each hog into the scalding vat.

A stunner and a sticker work in the area, which requires about 445 square feet for equipment and working space.



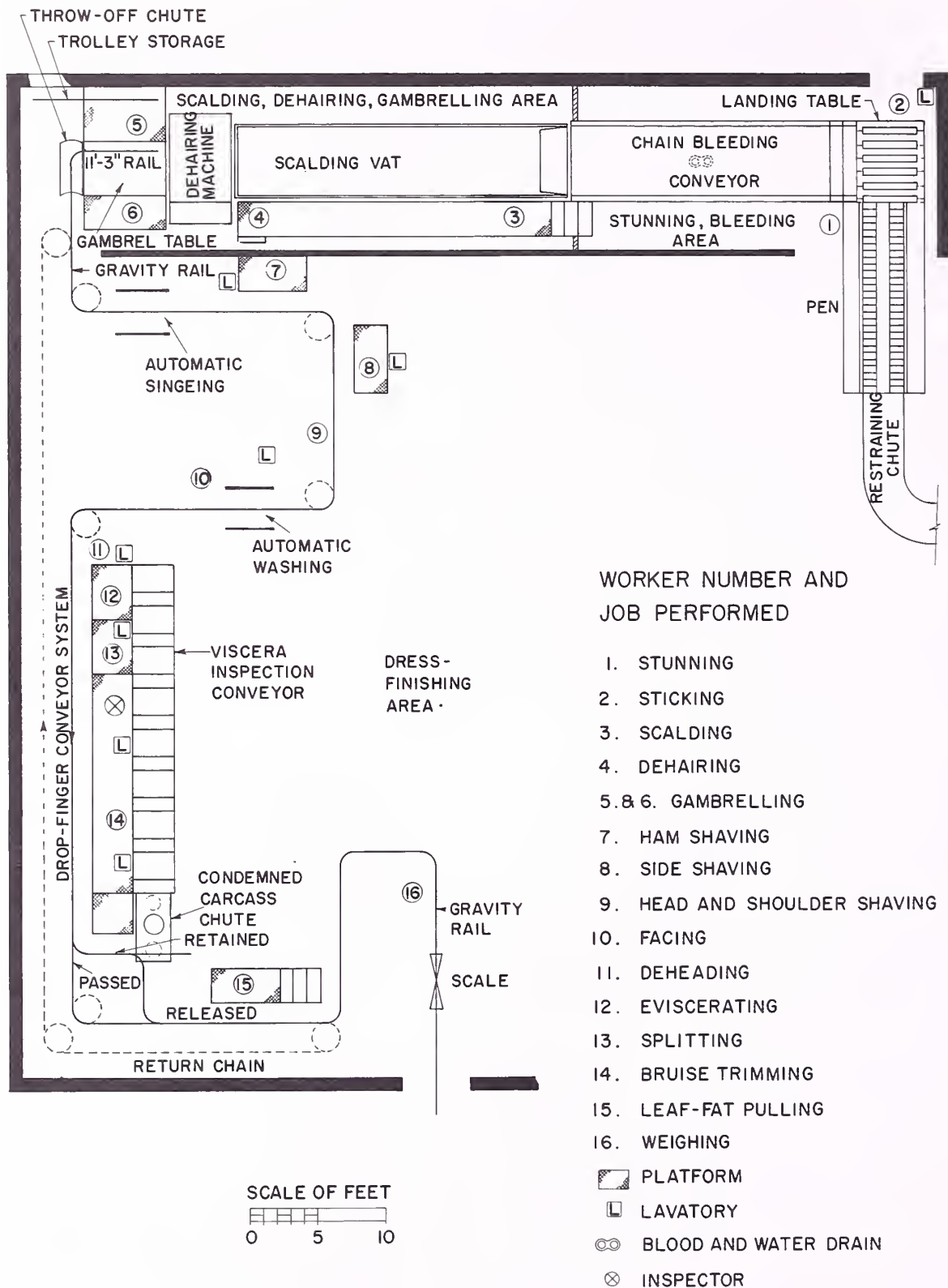


FIGURE 14.—Layout of a chain conveyor slaughtering system that handles about 100 hogs per hour.



**Scalding, dehairing, and gambrelling area.**—This area is identical to the same area in the powered rail system.

**Dress-finishing area.**—A slightly different arrangement is required for the dress-finishing area in this system because of the design of the stunning and bleeding area. As in the other systems, the dress-finishing area is separated from the other work areas by a full-height wall.

Except for the equipment arrangement (fig. 14), the dress-finishing area is identical to that in the powered rail system. Approximately 1,340 square feet of floor space is required to perform the dress-finishing operations.

### **Labor Requirements and Labor and Equipment Costs**

The operation requiring the most time to perform in this system—the pace-setting operation—is the same as in the powered rail system: Deheading, at 0.88 hour per 100 car-

casses (table 3). Weighing, though requiring a longer time than deheading, is not the pace-setting operation because the backlog rail ahead of the weighing station allows the powered section of rail to run at a speed greater than the weighing time limitations. Unproductive time is determined by the difference between the pace-setting time and all other operations, with the exception of stunning and sticking. The workers engaged in stunning and sticking help drive hogs during their wait time in dressing-line operations.

The labor and equipment costs per 100 carcasses are about the same as those of the powered rail system. Labor costs are the lowest of the three systems, but higher equipment costs bring the total up to that of the powered system.

Equipment requirements and costs are allocated to operations in appendix table 8. Elements of productive labor are in appendix table 11.

TABLE 3.—*Chain conveyor system: Crew organization, labor requirements, and labor and equipment costs to slaughter 100 hogs, by operation*

[Based on an annual volume of 97,500 hogs and average dressed carcass weight of 185 pounds]

Operation	Crew size	Labor requirements			Costs		
		Productive	Unproductive <sup>1</sup>	Total	Equipment	Labor	Total
	Number	Man-hours	Man-hours	Man-hours	Dollars	Dollars	Dollars
Stunning .....	1	0.42	0	20.42	0.95	0.84	1.79
Sticking .....	1	.43	0	3.43	1.77	.86	2.63
Scalding .....	1	.62	.26	.88	.61	1.76	2.37
Dehairing .....	1	.81	.07	.88	1.74	1.76	3.40
Gambrelling .....	2	41.40	.36	1.76	.74	3.52	4.16
Ham shaving .....	1	.84	.04	.88	.17	1.76	1.93
Side shaving .....	1	.81	.07	.88	.16	1.76	1.92
Head and shoulder shaving .....	1	.85	.03	.88	.10	1.76	1.86
Facing .....	1	.74	.14	.88	.10	1.76	1.86
Deheading .....	1	5.88	0	.88	.51	1.76	2.27
Eviscerating .....	1	.86	.02	.88	.52	1.76	2.28
Splitting .....	1	.86	.02	.88	.94	1.76	2.70
Bruise trimming .....	1	.72	.16	.88	.59	1.76	2.35
Leaf fat pulling .....	1	.82	.06	.88	.12	1.76	1.88
Weighing .....	1	6.91	0	.91	.15	1.82	1.97
Subtotal .....	16	11.97	1.23	13.20	8.97	26.40	35.37
Automatic singe .....	—	—	—	—	.67	—	.67
Automatic wash .....	—	—	—	—	.21	—	.21
Total .....	—	—	—	—	9.85	—	36.25

<sup>1</sup> Job-regulated wait time caused by irregular flow of work between operations.

<sup>2</sup> Excludes 0.46 man-hour devoted to driving.

<sup>3</sup> Excludes 0.45 man-hour devoted to driving.

<sup>4</sup> Includes time for two workers at 0.72 and 0.68 man-hour.

<sup>5</sup> Deheading is pace-setting operation.

<sup>6</sup> Not considered as pace-setting operation because rail backlog area is available.

## COMPARISON OF THREE HOG SLAUGHTERING SYSTEMS

Labor and equipment costs per 100 hogs of the three slaughtering systems covered in this study are given in table 4. Costs per 100 head for the powered rail system are \$4.67 less than those of the gravity rail system, and costs for the chain conveyor system are \$4.63 less than the gravity rail system. These two systems require fewer men and less time to perform the same work than the gravity rail system. Only nominal cost differences could be established between the chain conveyor and powered rail systems. The chain conveyor system requires more floor space than the other two systems. Construction costs for a facility should also be considered in choosing a slaughtering system.

Based on an annual volume of 97,500 head for half-day operations, labor and equipment costs of a plant using the chain conveyor system (\$35,344 annually) would be \$4,514 less per year than those of a plant using the gravity rail system (\$39,858 annually). On the same basis, costs for the powered rail system

(\$35,305 annually) would be \$4,553 less than those of the gravity rail system. Should all systems be operated on full-time basis, these savings would be more than doubled.

Total labor requirements, including productive and unproductive time, for operations in the chain conveyor system at 13.20 man-hours per 100 head are 3.11 man-hours less than those of the gravity rail system. In an 8-hour-day run, this could represent a saving of about 25 man-hours or \$50 to the packer. The powered rail system could be operated on an 8-hour-day run at a 21-man-hour saving over the gravity rail system.

The unproductive labor inherent in performing dressing operations is 2.75 man-hours for the gravity rail system and 1.23 man-hours for both the powered rail and chain conveyor systems. The more even line balance in the powered rail and chain conveyor systems permits the smaller wait-time requirements.

TABLE 4.—*Three hog slaughtering systems: Elapsed time, labor requirements, and labor and equipment costs per 100 head*

[Based on an annual volume of 97,500 hogs and average dressed carcass weight of 185 pounds]

System and crew required	Elapsed time	Labor requirements	Costs		
			Labor	Equipment	Total
	<i>Hours</i>	<i>Man-hours</i>	<i>Dollars</i>	<i>Dollars</i>	<i>Dollars</i>
Gravity rail, 18-man crew .....	0.97	16.31	32.62	8.26	40.88
Powered rail, 17-man crew .....	.88	13.74	27.48	8.73	36.21
Chain conveyor, 16-man crew .....	.88	13.20	26.40	9.85	36.25

## APPENDIX

Seven tables have been developed as aids in comparing equipment costs and labor requirements for the gravity rail, powered rail, and chain conveyor systems of hog slaughter.

Equipment costs were based on an annual volume of 97,500 hogs of an average dressed weight of 185 pounds per carcass and on an expected life of 12 years for each equipment item, as outlined in U.S. Treasury Department Internal Revenue Service publication No. 456 (9-62). Depreciation was calculated on a straight-line basis. Interest was computed at  $3\frac{1}{4}$  percent, the average yearly rate over the life of the equipment, which is based on the formula  $E = \frac{R(N+1)}{2N}$ , where  $E$  = average interest rate per year,  $R$  = interest rate required for investment (6 percent), and  $N$  = life expectancy of the item.

It is recognized that insurances and taxes will vary from one part of the country to another; however, 4 percent of the initial investment was assumed to be representative of nationwide requirements.

Equipment operating costs were determined

from power and water requirements for the number of hours of actual use annually and from data obtained in the plant studies.

Table 5 gives the ownership and operating costs per 100 hogs for each unit of equipment described in this report.

Tables 6, 7, and 8 present equipment requirements and costs per 100 hogs for the three systems, by operation, based on the number of units of equipment used in the system.

Tables 9, 10, and 11 describe the elements of each cycle of dressing-line operations, giving crew size, elapsed time, base time, allowances, and productive time for each operation in each system. Elapsed time is the actual time taken by a workman to complete an operation; base time is the time which is determined to be necessary for qualified workers, working at a pace which is ordinarily used under capable supervision; fatigue and personal allowance is the time added to the base time to allow for decreases or losses in production which might be attributed to fatigue and for the workers to attend to personal necessities. Productive time is the sum of base time and fatigue and personal allowance time.

TABLE 5.—Ownership and operating costs for 1 unit each of various types of hog slaughtering equipment

Equipment	Initial per unit cost (f.o.b. factory)	Ownership cost			Operating cost			Total annual cost	Cost per 100 hogs
		Depreciation	Interest <sup>1</sup>	Insurance and taxes <sup>2</sup>	Total	Power and water <sup>3</sup>	Maintenance <sup>4</sup>	Total	
	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars
Restraining chute (1½ ft. by 30 ft.)	900	75.00	29.25	36.00	140.25	0	22.50	162.75	0.1669
Stunning pen:									
Side squeeze	3,500	291.67	113.75	140.00	545.42	54.60	87.50	687.52	.7051
v-shaped, side conveyor	3,315	276.25	107.74	132.60	516.59	28.23	82.88	627.70	.6438
Electric stunner	595	49.58	19.34	23.80	92.72	24.38	14.87	131.97	.1354
Landing table (3 ft. by 5 ft.)	325	27.08	10.56	13.00	50.64	0	8.12	58.76	.0603
Hog shackles	6	.50	.20	.24	.94	0	.14	1.08	.0011
Jerkless hoist	2,100	175.00	68.25	84.00	327.25	54.60	52.50	434.35	.4455
13-foot gravity bleeding rail system with 49 feet of shackle return and dressing rail	282	23.50	9.17	11.28	43.95	0	7.05	51.00	.0523
Blood and water drain	62	5.17	2.02	2.48	9.67	0	1.55	11.22	.0115
21-foot chain conveyor with stick plate	8,569	714.08	278.49	342.76	1,335.33	54.60	214.40	1,604.33	1.6455
80-foot powered captive-shackle rail	1,700	141.67	55.25	68.00	264.92	18.17	42.50	325.59	.3339
Hydraulic unshackler	729	60.75	23.69	29.16	113.60	3.00	18.23	134.83	.1383
Scalding vat (5 ft. by 27 ft. by 3 ft.)	1,872	156.00	60.84	74.88	291.72	211.06	46.80	549.58	.5637
Work platforms:									
Dropper's (2½ ft. by 4 ft.)	250	20.83	8.12	10.00	38.95	0	6.25	45.20	.0464
Vat (2½ ft. by 25½ ft.)	510	42.50	16.58	20.40	79.48	0	12.75	92.23	.0946
Ham shave (2½ ft. by 5 ft. by 3½ ft.)	225	18.75	7.31	9.00	35.06	0	5.63	40.69	.0417
Side shave (2½ ft. by 5 ft. by 2½ ft.)	205	17.08	6.66	8.20	31.94	0	5.12	37.06	.0380
27 ft. viscera inspection conveyor	492	41.00	15.99	19.68	76.67	0	12.30	88.97	.0913
Leaf fat pull (2½ ft. by 8 ft.)	230	19.17	7.48	9.20	35.85	0	5.75	41.60	.0427
Dehairer with cradles	3,800	316.67	123.50	152.00	592.17	252.20	704.38	1,548.75	1.5885
Gambrel table with platforms, chute (4½ ft. by 9 ft.)	600	50.00	19.50	24.00	93.50	0	15.00	108.50	.1113
Hog trolley	2	.17	.07	.08	.32	0	.04	.36	.0004
Gambrel	1	.08	.03	.04	.15	0	.03	.18	.0002
Drop-finger conveyor with power drive and gravity rail extension	5,000	416.67	162.50	200.00	779.17	54.60	125.00	958.77	.9834
Singer:									
Automatic	2,250	187.50	74.14	90.00	350.63	171.58	56.25	578.46	.5933
Hand	25	2.08	.81	1.00	3.89	8.60	.62	13.11	.0134
Automatic washer	400	33.33	13.00	16.00	62.33	58.50	10.00	130.83	.1342



24 ft. viscera inspection conveyer .....	6,615	551.25	214.99	264.60	1,030.84	322.85	165.38	488.23	1,519.07	1.5580
Carcass saw .....	750	62.50	24.38	30.00	116.88	6.50	289.50	296.00	412.88	.4235
Condemned chute (2 ft. by 3½ ft.) .....	260	21.67	8.45	10.40	40.52	0	6.50	6.50	47.02	.0482
Sterilizing lavatory .....	155	12.92	5.04	6.20	24.16	5.65	16.57	22.22	46.38	.0476
Track scale .....	413	34.42	13.42	16.52	64.36	0	10.33	10.33	74.69	.0766

<sup>1</sup> Interest computed using the formula  $E = \frac{R(N+1)}{2N}$ , where  $E$  = average interest rate per year,  $R$  = interest rate required for investment (6 percent), and  $N$  = life expectancy of the item.

<sup>2</sup> Computed at 4 percent of initial investment.

<sup>3</sup> Electricity costs based on 2 cents per kilowatt-hour; water costs based on \$.00003 per gallon; gas cost based on \$.000284 per cu. ft.

<sup>4</sup> Because maintenance programs vary so much among packing plants, the figures should be considered only as approximations.

TABLE 6.—Gravity rail system: Equipment requirements and cost allocation, by operation

Operation and equipment	Unit	Cost per 100 hogs	Operation and equipment	Unit	Cost per 100 hogs
	Number	Dollars		Number	Dollars
Stunning:			Automatic wash:		
Restrain chute .....	1	0.1669	Drop-finger conveyor .....	$\frac{1}{13}$	.0756
Side squeeze stun pen .....	1	.7051	Washer .....	1	.1342
Electric stunner .....	1	.1354	Total .....		.2098
Total .....		1.0074	Facing:		
Shackling:			Drop-finger conveyor .....	$\frac{1}{13}$	.0756
Hog shackles .....	35	.0385	Sterilizing lavatory .....	$\frac{1}{2}$	.0238
Landing table .....	1	.0603	Total .....		.0994
Jerkless hoist .....	1	.4455	Deheading:		
Total .....		.5443	Drop-finger conveyor .....	$\frac{1}{13}$	.0756
Sticking and dropping:			Sterilizing lavatory .....	1	.0476
Gravity bleeding rail .....	1	.0523	Inspection conveyor .....	$\frac{1}{4}$	.3895
Blood and water drain .....	1	.0115	Total .....		.5127
Dropper's platform .....	1	.0464	Eviscerating:		
Sterilizing lavatory .....	1	.0476	Drop-finger conveyor .....	$\frac{1}{13}$	.0756
Total .....		.1578	Sterilizing lavatory .....	$\frac{1}{2}$	.0238
Scalding:			Inspection conveyor .....	$\frac{1}{4}$	.3895
Scalding vat .....	1	.5637	Conveyor platform .....	$\frac{1}{3}$	.0304
Vat platform .....	$\frac{1}{2}$	.0473	Total .....		.5193
Total .....		.6110	Splitting:		
Dehairing:			Drop-finger conveyor .....	$\frac{1}{13}$	.0756
Vat platform .....	$\frac{1}{2}$	.0473	Sterilizing lavatory .....	$\frac{1}{2}$	.0238
Dehairer .....	1	1.5885	Carcass saw .....	1	.4235
Total .....		1.6358	Inspection conveyor .....	$\frac{1}{4}$	.3895
Gambrelling:			Conveyor platform .....	$\frac{1}{3}$	.0304
Gambrel table .....	1	.1113	Total .....		.9428
Hog trolley .....	750	.3000	Bruise trimming:		
Gambrel .....	750	.1500	Drop-finger conveyor .....	$\frac{1}{13}$	.0756
Drop-finger conveyor .....	$\frac{1}{13}$	.0756	Sterilizing lavatory .....	1	.0476
Total .....		.6369	Inspection conveyor .....	$\frac{1}{4}$	.3895
Singeing:			Conveyor platform .....	$\frac{1}{3}$	.0304
Drop-finger conveyor .....	$\frac{1}{13}$	.0756	Condemned chute .....	1	.0482
Hand singer .....	1	.0134	Total .....		.5913
Total .....		.0890	Leaf fat pulling:		
Ham scraping:			Drop-finger conveyor (gravity rail extension) .....	$\frac{1}{13}$	.0756
Ham shave platform .....	1	.0417	Leaf fat pull platform .....	1	.0427
Drop-finger conveyor .....	$\frac{1}{13}$	.0756	Total .....		.1183
Sterilizing lavatory .....	1	.0476	Weighing:		
Total .....		.1649	Drop-finger conveyor (gravity rail extension) .....	$\frac{1}{13}$	.0756
Side shaving:			Track scale .....	1	.0766
Side shave platform .....	1	.0380	Total .....		.1522
Drop-finger conveyor .....	$\frac{1}{13}$	.0756			
Sterilizing lavatory .....	1	.0476			
Total .....		.1612			
Head and shoulder shaving:					
Drop-finger conveyor .....	$\frac{1}{13}$	.0756			
Sterilizing lavatory .....	$\frac{1}{2}$	.0238			
Total .....		.0994			

TABLE 7.—*Powered rail system: Equipment requirements and cost allocation, by operation*

Operation and equipment	Unit		Cost per 100 hogs	Operation and equipment	Unit		Cost per 100 hogs
	Number	Dollars			Number	Dollars	
Stunning:				Automatic washing:			
Restrain chute .....	1	0.1669		Drop-finger conveyor .....	$\frac{1}{13}$	.0756	
Side squeezer stun pen .....	1	.7051		Automatic washer .....	1	.1342	
Electric stunner .....	1	.1354		Total .....	.....	.2098	
Total .....	.....	1.0074		Facing:			
Sticking and shackling:				Drop-finger conveyor .....	$\frac{1}{13}$	.0756	
Landing table .....	1	.0603		Sterilizing lavatory .....	$\frac{1}{2}$	.0238	
Blood and drain .....	1	.0115		Total .....	.....	.0994	
Power bleeding rail .....	1	.3339		Deheading:			
Sterilizing lavatory .....	1	.0476		Drop-finger conveyor .....	$\frac{1}{13}$	.0756	
Total .....	.....	.4533		Sterilizing lavatory .....	1	.0476	
Scalding:				Inspection conveyor .....	$\frac{1}{4}$	.3895	
Scalding vat .....	1	.5637		Total .....	.....	.5127	
Vat platform .....	$\frac{1}{2}$	.0473		Eviscerating:			
Hydraulic unshackler .....	1	.1383		Drop-finger conveyor .....	$\frac{1}{13}$	.0756	
Total .....	.....	.7493		Sterilizing lavatory .....	$\frac{1}{2}$	.0238	
Dehairing:				Inspection conveyor .....	$\frac{1}{4}$	.3895	
Vat platform .....	$\frac{1}{2}$	.0473		Conveyor platform .....	$\frac{1}{3}$	.0304	
Dehairer .....	1	1.5885		Total .....	.....	.5193	
Total .....	.....	1.6358		Splitting:			
Gambrelling:				Drop-finger conveyor .....	$\frac{1}{13}$	.0756	
Gambrel table .....	1	.1113		Sterilizing lavatory .....	$\frac{1}{2}$	.0238	
Hog trolley .....	750	.3000		Inspection conveyor .....	$\frac{1}{4}$	.3895	
Hog gambrel .....	750	.1500		Conveyor platform .....	$\frac{1}{3}$	.0304	
Drop-finger conveyor .....	$\frac{1}{13}$	.0756		Carcass saw .....	1	.4235	
Total .....	.....	.6369		Total .....	.....	.9428	
Automatic singe:				Bruise trimming:			
Drop-finger conveyor .....	$\frac{1}{13}$	.0756		Drop-finger conveyor .....	$\frac{1}{13}$	.0756	
Automatic singer .....	1	.5933		Sterilizing lavatory .....	1	.0476	
Total .....	.....	.6689		Inspection conveyor .....	$\frac{1}{4}$	.3895	
Ham shaving:				Conveyor platform .....	$\frac{1}{3}$	.0304	
Drop-finger conveyor .....	$\frac{1}{13}$	.0756		Condemned chute .....	1	.0482	
Ham shave platform .....	1	.0417		Total .....	.....	.5913	
Sterilizing lavatory .....	1	.0476		Leaf fat pulling:			
Total .....	.....	.1649		Drop-finger conveyor .....	$\frac{1}{13}$	.0756	
Side shaving:				Leaf fat pull platform .....	1	.0427	
Drop-finger conveyor .....	$\frac{1}{13}$	.0756		Total .....	.....	.1183	
Sterilizing lavatory .....	1	.0476		Weighing:			
Side shave platform .....	1	.0380		Drop-finger conveyor (gravity			
Total .....	.....	.1612		rail extension) .....	$\frac{1}{13}$	.0756	
Head and shoulder shaving:				Track scale .....	1	.0766	
Drop-finger conveyor .....	$\frac{1}{13}$	.0756		Total .....	.....	.1522	
Sterilizing lavatory .....	$\frac{1}{2}$	.0238					
Total .....	.....	.0994					



TABLE 8.—*Chain conveyor system: Equipment requirements and cost allocation, by operation*

Operation and equipment	Unit	Cost per 100 hogs	Operation and equipment	Unit	Cost per 100 hogs
	<i>Number</i>	<i>Dollars</i>		<i>Number</i>	<i>Dollars</i>
Stunning:			Automatic washing:		
Restrain chute .....	1	.01669	Drop-finger conveyor .....	$\frac{1}{13}$	.0756
Electric stunner .....	1	.1354	Automatic washer .....	1	.1342
"V" side conveyor pen .....	1	.6438	Total .....		.2098
Total .....		.9461	Facing:		
Sticking:			Drop-finger conveyor .....	$\frac{1}{13}$	.0756
Landing table .....	1	.0603	Sterilizing lavatory .....	$\frac{1}{2}$	.0238
Blood and water drain .....	1	.0115	Total .....		.0994
Chain conveyor .....	1	1.6455	Deheading:		
Sterilizing lavatory .....	1	.0476	Drop-finger conveyor .....	$\frac{1}{13}$	.0756
Total .....		1.7649	Sterilizing lavatory .....	1	.0476
Scalding:			Inspection conveyor .....	$\frac{1}{4}$	.3895
Scalding vat .....	1	.5637	Total .....		.5127
Vat platform .....	$\frac{1}{2}$	.0473	Eviscerating:		
Total .....		.6110	Drop-finger conveyor .....	$\frac{1}{13}$	.0756
Dehairing:			Sterilizing lavatory .....	$\frac{1}{2}$	.0238
Vat platform .....	$\frac{1}{2}$	.0473	Inspection conveyor .....	$\frac{1}{4}$	.3895
Dehairer .....	1	1.5885	Conveyor platform .....	$\frac{1}{3}$	.0304
Total .....		1.6358	Total .....		.5193
Gambrelling:			Splitting:		
Gambrel table .....	1	.1113	Drop-finger conveyor .....	$\frac{1}{13}$	.0756
Hog trolley .....	750	.3000	Sterilizing lavatory .....	$\frac{1}{2}$	.0238
Hog gambrel .....	750	.1500	Inspection conveyor .....	$\frac{1}{4}$	.3895
Drop-finger conveyor .....	$\frac{1}{13}$	.0756	Conveyor platform .....	$\frac{1}{3}$	.0304
Total .....		.6369	Carcass saw .....	1	.4235
Automatic singeing:			Total .....		.9428
Drop-finger conveyor .....	$\frac{1}{13}$	.0756	Bruise trimming:		
Automatic singer .....	1	.5933	Drop-finger conveyor .....	$\frac{1}{13}$	.0756
Total .....		.6689	Sterilizing lavatory .....	1	.0476
Ham shaving:			Inspection conveyor .....	$\frac{1}{4}$	.3895
Drop-finger conveyor .....	$\frac{1}{13}$	.0756	Conveyor platform .....	$\frac{1}{3}$	.0304
Sterilizing lavatory .....	1	.0476	Condemned chute .....	1	.0482
Ham shave platform .....	1	.0417	Total .....		.5913
Total .....		.1649	Leaf fat pulling:		
Side shaving:			Drop-finger conveyor .....	$\frac{1}{13}$	.0756
Drop-finger conveyor .....	$\frac{1}{13}$	.0756	Leaf fat pull platform .....	1	.0427
Sterilizing lavatory .....	1	.0476	Total .....		.1183
Side shave platform .....	1	.0380	Weighing:		
Total .....		.1612	Drop-finger conveyor (gravity		
Head and shoulder shaving:			rail extension) .....	$\frac{1}{13}$	.0756
Drop-finger conveyor .....	$\frac{1}{13}$	.0756	Track scale .....	1	.0766
Sterilizing lavatory .....	$\frac{1}{2}$	.0238	Total .....		.1522
Total .....		.0994			

TABLE 9.—Gravity rail system: Labor required per 100 hogs, by operation

[Dressed carcass average = 185 pounds]

Operation and elements	Workers	Elapsed time	Base time	Fatigue and personal allowance	Productive time
	<i>Number</i>	<i>Hours</i>	<i>Man-hours</i>	<i>Man-hours</i>	<i>Man-hours</i>
<i>Stunning</i> —Actuate electric stunner, actuate pen squeezer action, stun hog, release pen squeeze action .....	1	0.48	0.41	0.07	0.48
<i>Shackling</i> —Get shackle, shackle right hind leg, attach shackle to jerkless hoist, guide hog off conveyor.....	1	.36	.30	.06	.36
<i>Sticking and dropping</i> —Get knife, stick, replace knife, wash hands and tools, walk to dropper's platform, release shackle to drop hog, return shackle, walk to stick area (4 hogs per cycle) .....	1	.60	.50	.10	.60
<i>Scalding</i> —Attend scald vat, use pole to turn hogs and push along toward dehair end, look for sinkers.....	1	.62	.52	.10	.62
<i>Dehairing</i> —Attend dehair machine, position 2 hogs on cradle, dump into machine, return cradle, position 1 hog on cradle, dump into machine, return cradle, allow dehairing time, dump 3 hogs onto gambrel table, return cradle .....	1	.81	.71	.10	.81
<i>Gambrelling</i> —Cut gam, remove toenails, get and insert gambrel, get and insert trolley in gambrel, hang on rail, scrape excess hair from head and forelegs, set up trolley .....	2	.70	1.19	.21	1.40
<i>Singeing</i> —Use hand torch to singe hair left on carcass, position carcass for singe .....	1	.84	.76	.08	.84
<i>Ham shaving</i> —Use hand knife to scrape hind quarters and legs, wash hands and knives .....	1	.84	.76	.08	.84
<i>Side shaving</i> —Scrape sides, wash hands and knives.....	1	.81	.74	.07	.81
<i>Head and shoulder shaving</i> —Scrape head and shoulder area, wash hands and knives .....	1	.85	.77	.08	.85
<i>Facing</i> —Remove eyelashes, eardrums, skin face, trim legs and feet, steel knife, wash hands and knives....	1	.74	.66	.08	.74
<i>Deheading</i> —Sever head, open brisket, transfer head to inspection conveyor, steel knife, wash hands and knives .....	1	.88	.73	.15	.88
<i>Eviscerating</i> —Eviscerate carcass, place viscera and pluck in inspection pan, steel knife, wash hands and knives .....	1	.86	.70	.16	.86
<i>Splitting</i> —Position saw, saw, rinse saw, scrape blood clot from shoulder, wash inside carcass, wash hands and knives .....	1	.86	.72	.14	.86
<i>Bruise trimming</i> —Use hand knife to trim bruises, wash hands and knives .....	1	.72	.66	.06	.72
<i>Leaf fat pulling</i> —Position carcass, pull leaf fat, face hams, remove kidneys, push carcass on rail, steel knife .....	1	.97	.85	.12	.97
<i>Weighing</i> —Walk to and push 4-5 carcasses to weigh area, wash neck area, move carcasses onto scales, weigh, record weight, move off scales, stamp .....	1	.92	.82	.10	.92

TABLE 10.—*Powered rail system: Labor required per 100 hogs, by operation*

[Dressed carcass average = 185 pounds]

Operation and elements	Workers	Elapsed time	Base time	Fatigue and personal allowance	Productive time
	<i>Number</i>	<i>Hours</i>	<i>Man-hours</i>	<i>Man-hours</i>	<i>Man-hours</i>
<i>Stunning</i> —Actuate electric stunner, actuate pen squeeze action, stun hog, release pen squeeze action .....	1	0.48	0.41	0.07	0.48
<i>Sticking and shackling</i> —Position hog, stick, shackle, wash hands and knives .....	2	.45	.78	.12	.90
<i>Scalding</i> —Attend scald vat, use pole to turn hogs and push along toward dehair end, look for sinkers .....	1	.62	.53	.09	.62
<i>Dehairing</i> —Attend dehair machine, position 2 hogs on cradle, dump into machine, return cradle, position 1 hog on cradle, dump into machine, return cradle, allow dehairing time, dump 3 hogs onto gambrel table, return cradle .....	1	.81	.71	.10	.81
<i>Gambrelling</i> —Cut gam, remove toenails, get and insert gambrel, get and insert trolley in gambrel, hang on rail, scrape excess hair from head and fore-legs, set up trolleys .....	2	.70	1.19	.21	1.40
<i>Ham shaving</i> —Use hand knife to scrape hind quarters and legs, wash hands and knives .....	1	.84	.76	.08	.84
<i>Side shaving</i> —Scrape sides, wash hands and knives .....	1	.81	.74	.07	.81
<i>Head and shoulder shaving</i> —Scrape head and shoulder area, wash hands and knives .....	1	.85	.77	.08	.85
<i>Facing</i> —Remove eyelashes, eardrums, skin face, trim legs and feet, steel knife, wash hands and knives .....	1	.74	.66	.88	.74
<i>Deheading</i> —Sever head, open brisket, transfer head to inspection conveyor, steel knife, wash hands and knives .....	1	.88	.73	.15	.88
<i>Eviscerating</i> —Eviscerate, place viscera and pluck in inspection pan, steel knife, wash hands and knives .....	1	.86	.70	.16	.86
<i>Splitting</i> —Position saw, saw, rinse saw, scrape blood clot from shoulder area, wash inside, wash hands and knives .....	1	.86	.72	.14	.86
<i>Bruise trimming</i> —Use hand knife to trim bruises, wash hands and knives .....	1	.72	.66	.06	.72
<i>Leaf fat pulling</i> —Pull fat, face hams, remove kidneys, steel knife .....	1	.82	.73	.09	.82
<i>Weighing</i> —Walk to and push 4-5 carcasses to weigh area, wash neck, move onto scale, weigh, record, move off scales, stamp.	1	.92	.82	.10	.92



TABLE 11.—*Chain conveyor system: Labor required per 100 hogs, by operation*

[Dressed carcass average = 185 pounds]

Operation and elements	Workers	Elapsed time	Base time	Fatigue and personal allowance	Productive time
	<i>Number</i>	<i>Hours</i>	<i>Man-hours</i>	<i>Man-hours</i>	<i>Man-hours</i>
<i>Stunning</i> —Use electric stunner to stun hogs .....	1	0.42	0.36	0.06	0.42
<i>Sticking</i> —Position carcass, stick, actuate dump plate, wash hands and knives .....	1	.43	.38	.05	.43
<i>Scalding</i> —Same as powered rail system .....	1	.62	.53	.09	.62
<i>Dehairing</i> —Same as powered rail system .....	1	.81	.71	.10	.81
<i>Gambrelling</i> —Same as powered rail system .....	2	.70	1.19	.21	1.40
<i>Ham shaving</i> —Same as powered rail system .....	1	.84	.76	.08	.84
<i>Side shaving</i> —Same as powered rail system .....	1	.81	.74	.07	.81
<i>Head and shoulder shaving</i> —Same as powered rail system .....	1	.85	.77	.08	.85
<i>Facing</i> —Same as powered rail system .....	1	.74	.66	.08	.74
<i>Deheading</i> —Same as powered rail system .....	1	.88	.83	.15	.88
<i>Eviscerating</i> —Same as powered rail system .....	1	.86	.70	.16	.86
<i>Splitting</i> —Same as powered rail system .....	1	.86	.72	.14	.86
<i>Bruise trimming</i> —Same as powered rail system .....	1	.72	.66	.06	.72
<i>Leaf fat pulling</i> —Same as powered rail system .....	1	.82	.73	.09	.82
<i>Weighing</i> —Same as powered rail system except 5 feet less walking distance .....	1	.91	.81	.10	.91







